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Silicon startup schools: technocracy, algorithmic imaginaries and venture philanthropy in corporate education reform

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ABSTRACT

Technology companies are investing billions of dollars in educational technology, but also creating their own alternative schools. This article traces the emergence of four prototypical ‘silicon startup schools’ as exemplars of a technocratic mode of corporatized education reform: IBM’s P-TECH, part of its Smarter Cities program; AltSchool, a chain of schools based on ‘makerspaces’ established by a former Google executive; Kahn Lab School, a new ‘experimental’ school launched by the founder of the online Kahn Academy; and XQ Super School Project, a ‘crowdsourcing’ project to redesign American high schools funded philanthropically by the wife of Steve Jobs of Apple. Startup schools are analysed as prototype educational institutions that originate in the culture, discourse and ideals of Silicon Valley venture capital and startup culture, and that are intended to relocate its practices to the whole social, technical, political and economic infrastructure of schooling. These new schools are being designed as scalable technical platforms; funded by commercial ‘venture philanthropy’ sources; and staffed and managed by executives and engineers from some of Silicon Valley’s most successful startups and web companies. Together, they constitute a powerful shared ‘algorithmic imaginary’ that seeks to ‘disrupt’ public schooling through the technocratic expertise of Silicon Valley venture philanthropists.

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Major global technology companies and venture capital investment firms have begun to concentrate significant technical and financial resources in education in recent years. Though Silicon Valley is routinely satirized for its discourse of ‘radically disruptive’ technology entrepreneurship (Rabin, 2015), the Silicon Valley vocabulary is becoming part of the language of education, and is galvanizing significant financial and research and development practices in educational technology (‘ed-tech’). Technology companies are investing with unprecedented optimism in ed-tech, with an estimated \$1.6-billion US dollars of venture capital invested in the sector in the first half of 2015 alone (Wan & McNally, 2015), following a massive escalation in funding over the previous five years (Lynch, 2015a). A notable indicator of Silicon Valley’s enthusiasm for ed-tech investment is the annual event HackingEdu, held in San Francisco, which attracts over a thousand young software programmers and hackers to help ‘revolutionize the education industry’, while competing for over \$100,000 US dollars in prizes, and is supported by

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major Silicon Valley firms including IBM, Google and Uber. Additionally, a number of ed-tech ‘incubator’ and ‘accelerator’ programs have been established to support the sector in Silicon Valley. Incubators help new startups to test and validate ideas, while accelerators turn products into scalable businesses, often through direct equity investment, and provide legal, technical and financial services along with mentorship, working space and access to educators, entrepreneurs, business partners and potential investors (Gomes, 2015). New trends in ed-tech investment, ‘edu-hacking’ and ‘edu-preneurship’ are combining to produce new networks of financial and technical expertise in education; networks whose practices derive from the corporate tech-entrepreneurial sector and are increasingly attractive in the education sector.

In a significant twist, Silicon Valley entrepreneurs are also beginning to use their technical and financial power to create and prototype their own new schools. In the five years from 2011, IBM launched P-TECH, a network of schools modelled to fit its Smarter Cities global program; a former Google executive established AltSchool, a chain of schools designed more like ‘makerspaces’ than conventional schools, with financial support from Facebook; the founder of Khan Academy opened his own Kahn Lab School as an experimental site to test out new technologies and theories of learning; and the widow of Steve Jobs of Apple dedicated both her philanthropic expertise and a major donation to a ‘crowdsourced’ school redesign competition, XQ: Super School Project. In this article I trace the emergence of these ‘silicon startup schools’ as new prototypical educational institutions that originate in the ideals of Silicon Valley startup culture and are designed to relocate its practices to the organization of schooling.

The critical argument is that these schools are prototypical of a technocratic mode of corporate education reform, one that goes beyond the implantation of educational technology in schools but instead brings schools into private hands as testbeds for a model of schooling that is rooted in the embedded technological knowledges, assumptions, and practices of corporate technology culture rather than the values and purposes of public education. In other words, they see technical innovation as a model for political invention (Barry, 2001), and exemplify how a ‘technocratic mentality and knowledge’ increasingly influences public institutions such as education (Ribbhagen, 2011). As Ribbhagen (2011, p. 24) notes, a ‘technocratic mentality’ can be characterized by its strict scientific approach, decision-making based on technical knowledge, and scepticism toward political institutions and processes of political democracy. However, there is a clear politics to technocratic expertise. Technocrats are not apolitical actors whose decision-making rests on forms of technical analysis that are neutral or value-free, but experts whose technical knowledge and innovation have the capacity to change institutions and therefore to impact upon human capacities and attributes. In this sense, Silicon Valley’s startup schools are the products of a technocratic mentality in contemporary education. These new schools are being designed as scalable technical platforms, underpinned by software engineering expertise; they are funded by commercial and venture capital and philanthropic sources; staffed and managed by entrepreneurs, executives and engineers from some of Silicon Valley’s most successful startups and web companies; and proposed to reinvent, reimagine and rebuild education in the mould of Silicon Valley itself. Such schools offer technical and corporate solutions to the seemingly intractable problems of public education. The interweaving of technical expertise, venture capital and philanthropy associated with the technocratic mentality of

Silicon Valley technology companies is leading to the production of a shared vision of the future of schooling, and its materialization as prototype startup school projects that privilege corporatized education reform as the solution to public education. This article offers an original analysis of the website content from these four projects and associated media commentary, additionally informed by web searches on their founding originators, commercial sponsors and funders, as a way of establishing startup schools as an important emerging site of corporatized technocratic education reform that requires further examination and critique.

Venture philanthropy

Projects such as P-TECH, AltSchool, Kahn Lab School and XQ Super School rely on practices of ‘venture philanthropy’ or ‘philanthrocapitalism’ that combine venture capital sources of investment with philanthropic giving. In the US, venture philanthropy in education is evidenced by the participation of business-backed charitable foundations and wealthy elites in charter school networks (Au & Ferrare, 2015; Reckhow, 2013), both on the ‘supply side’ by direct funding new brand-name charter schools, and on the ‘demand side’ by sponsoring advocacy organizations (Saltman, 2010), while in the UK, it is evident in the entry of both new philanthropic sources and private equity in the academy schools program (Ball & Junemann, 2012). As Lubienski (2013, p. 498) notes, US charter schools enable private organizations to penetrate the publicly funded education sector, govern institutions directly, and to advocate more competitive, deregulated models for public education, thus ‘serving as a vehicle for privatizing public policy – diminishing the public while enhancing the position and influence of private interests and organizations in education policymaking’. According to Saltman (2010, p. 13), the business-oriented agenda of venture philanthropy contributes to a greater ‘corporatization of schools’, ‘both the privatization of public schools and the transformation of public schools on the model of the corporation’. Likewise, silicon startup schools explicitly seek to remodel schools on the template of successful tech sector businesses, and they are doing so either by opening their own new private schools or by transforming existing public schools to be more business-oriented.

Commercial involvement in schools has a long documented history (see Ball, 2007; Molnar, 2005), but the rise of venture philanthropy through technology companies and entrepreneurial individuals is more recent. ‘Champions of philanthrocapitalism suggest that private giving can fill the void left by diminished government spending on social and development programmes’, claims McGoe (2014, p. 109), but also that ‘new philanthropic initiatives have compelled increased financial support from governments toward the private sector’. Olmedo (2014) terms this ‘philanthropic governance’ to refer to how venture philanthropists have brought important changes to how education is enacted – including the reorientation of governments and the public sector to embrace the model of venture philanthropy from the private sector. For Reckhow (2013), the new ‘Boardroom Progressives’ represented by corporate philanthropists (many from successful technology companies) are impatient with public bureaucracies and have focused instead on creating a broad network of private and nonprofit alternatives for developing and running schools. These new ‘policy entrepreneurs’ emphasize the collection and analysis of data as a way of evaluating school effectiveness, advocate

enhanced school choice, educational markets and competitiveness, and have gone beyond the realm of charity and into the realm of education policy and politics, able to shape the direction of education reform (Reckhow, 2013). As Saltman (2010, p. 60) argues, the concentrated financial support of venture philanthropy represents a ‘coordinated anti-public movement’ that raises ‘issues of public governance but also the spectre of a small number of people being able to destroy the public school system’ through ‘weakening rather than investing in public schooling’.

New digital technologies are a key part of the strategies being employed by venture philanthropy to reform schools. Roberts-Mahoney, Means and Garrison (2016, p. 1–2), for example, argue that powerful venture philanthropies, educational technology companies and the US Department of Education have combined to form ‘a growing movement to apply “big data” through “learning analytics” to create “personalized learning” in K-12 education in the United States’, which they argue reflects ‘narrow corporate-driven educational policies and priorities such as privatization, standardization, high-stakes assessment, and systems of corporate management and accountability’. The embedded technocratic values and assumptions circulating in such a corporatized education reform movement are, therefore, reflected in the technical systems they create and mobilize to realize their ambitions.

The silicon startup schools profiled below represent the next step in corporate education reform by venture philanthropy. They importantly need to be understood within the recent history of corporatized education policy entrepreneurship, but also as the distinctively technocratic products of technology entrepreneurs with specific software platforms, practices and forms of technical expertise at their disposal. Rather than tinkering in the margins of state schooling to increase efficiencies and effectiveness by implanting new technologies in classrooms, Silicon Valley is seeking to ‘radically disrupt’ the established model of the school through both its technical practices and its venture philanthropic modes of governance. This is leading to a distinctively technocratic approach to education governance, with technical expertise displacing other forms of knowledge and decision-making practice. Through venture philanthropy, the technology sector is becoming a ‘supply side’ provider of education, directly inserting itself into the organization of schooling through prototype projects and technologies, and simultaneously a ‘demand side’ campaigning platform for educational reform, and as such it is reinforcing the ‘privatization of schooling’ – to make schools function in ways that reflect competitively driven, private-style organizational behaviours – as well as shifting ‘policymaking power from public to private control’ (Lubienski, 2013, p. 499). Particularly notably, it is seeking to reimagine schooling according to a technological template that has dominated the ambitions of private sector Silicon Valley companies.

Algorithmic imaginaries

By tracing the emergence of startup schools, the focus of this article is on the forms of technocratic mentality and imagination that informs them, making methodological use of the concept of ‘sociotechnical imaginaries’ from science and technology studies (STS). Sociotechnical imaginaries refer to collectively held, institutionally stabilized and publicly performed visions of desirable futures that are animated by shared

understandings of forms of social life and social order and made attainable through the design of technological projects (Jasanoff, 2015). Sociotechnical imaginaries are not just science fiction fantasies. The dreamscapes of the future that are dreamt up in science laboratories and technical R&D departments sometimes, through collective efforts, become stable and shared objectives that are used in the design and production of actual technologies and scientific innovations – developments that then incrementally produce or materialize the desired future. Imaginaries in this sense act as models or diagrams to which certain actors hope to make reality conform, serving as ‘distillations of practices’ for the shaping of behaviours and technologies for visualizing and governing particular ways of life and forms of social order (Huxley, 2007, p. 194).

In the particular context of social media and web companies, Mager (2015, p. 5–6) describes ‘algorithmic imaginaries’ that emerge from ‘a very specific economic and innovative culture’ associated with Silicon Valley technology companies, and that privilege their originators’ ‘techno-euphoric interpretations of Internet technologies as driving forces for economic and social progress’. The figure of the algorithm is especially important here. The kinds of computing techniques that underpin many new and emerging data analytics systems are based on machine learning algorithms that can be ‘trained’ on past data to then detect patterns in existing data and consequently calculate predictions of probable future actions and outcomes (Mackenzie, 2015). In this sense, machine learning algorithms are a future-tense technology that contribute to new forms of anticipatory governance, whereby people’s actions and possibilities may be calculated and pre-empted. The notion of an algorithmic imaginary thus captures the Silicon Valley ideal of calculating, predicting and pre-empting human behaviours and social institutions through technical platforms that are increasingly automated and data-driven. The technocratic ideal of complete scientific calculability and technical objectivity associated with algorithmic practice underpins its approach.

In particular, the imaginary spaces of startup schools detailed below depend on the social production of particular digital technologies for their functioning. Kitchen and Dodge (2011) have influentially conceptualized ‘code/space’ to describe spatial environments that depend on computer code to operate as intended. Code/spaces depend on the written script of lines of code, but for Kitchen and Dodge (2011, p. 26) the code is not merely technical; it is also socially produced towards the accomplishment of specific objectives:

The code created is the manifestation of a system of thought – an expression of how the world can be captured, represented, processed, and modelled computationally with the outcome subsequently doing work in the world. Programming then fundamentally seeks to capture and enact knowledge about the world – practices, ideas, measurements, locations, equations and images – in order to augment, mediate and regulate people’s lives.

Likewise, Mackenzie (2015) notes that the kinds of predictions offered by machine learning systems are themselves social products, since training data always has to be selected and the accuracy of the predictions generated need to be checked by technical experts. Moreover, code is not just the product of programmers, but is nested within a complex system of hardware, software, operating systems and standards, and is framed by contexts including organizational plans, legalities, marketplaces and financial arrangements.

By combining the concept of code/space with that of technocratic mentalities and algorithmic imaginaries, my intention is to grasp how imagined futures are both expressed in a system of thought and manifested in code in ways that then fabricate the spaces that people inhabit. As the product of technocratic expertise, code/space therefore embeds the imaginaries, ideas, objectives and business plans of programmers, their employers and their financiers into the fabrication and functioning of specific places, with significant consequences for how lives are experienced and governed. In other words, sociotechnically produced algorithmic imaginaries of technically supported spaces become more than models or diagrams of imagined future spaces, but in their subsequent materialization become spaces to inhabit and experience in the present, as sociospatial models and containers of a desirable future. In this sense, the current algorithmic imaginaries of education being dreamt up in Silicon Valley offices and materialized through the injection of philanthrocapital are becoming the lived reality of education, and need to be critically examined for the material effects they might exert. In the analysis of startup schools that follow, I argue that these new technologically enabled educational institutions have been constructed in accordance with the technocratic mentalities and algorithmic imagination of their designers in ways which reinforce and reproduce their values, aspirations and desires. It is a certain Silicon Valley technocratic imaginary that is increasingly infusing educational thinking and is inscribed in the redesign of the spaces of schooling for the future. As a consequence, such projects propose to transform schools into code/spaces that are orchestrated through both lines of code but also the cultures of code of their designers, as well as being regulated by the legal, financial and ethical codes of conduct associated with Silicon Valley technology culture. The fabrication of silicon startup schools relies on Silicon Valley venture philanthropy and policy entrepreneurship for its materialization and operationalization, and makes their philanthrocapitalist founders into powerful technocratic reformatory actors in the envisioning and prototyping of the future of schooling.

Smarter schools

Technology companies are becoming significant ‘supply side’ providers of new models of schooling. A significant example is P-TECH (Pathways in Technology Early College High School – see <http://www.ptech.org/>), a chain school model for high school education designed and promoted by the IBM Corporation. Its emphasis is on vocational education for careers in science, technology, engineering and maths (STEM). Many students are offered internships at IBM itself during the course of their studies, and to date some of its graduates have continued to full employment with the company. The model originated in 2011 at P-TECH Brooklyn in New York, through a partnership of the New York City Department of Education, The City University of New York, New York City College of Technology and IBM Corporation. It was the result of meetings between New York’s former Chancellor of Education Joel Klein and IBM’s then-CEO Samuel Palmisano in 2010, and conceived as a way of connecting education and employment, in particular to equip students with the same skills and degrees that IBM demands of its own employees.

By 2015 P-TECH had expanded to around 40 schools in the US, with plans for expansion into Australia after a visit from its Prime Minister. Barack Obama himself has visited a P-TECH school and declared it a successful model. The mayor of Chicago has ‘ordered’ 4 P-TECH schools for the city after meetings with the New York state governor. It has even been profiled in *Wired* magazine, in an article entitled ‘IBM’s School Could Fix Education – And Tech’s Diversity Gap’, which noted the careers pipeline into the tech sector represented by its approach:

Tech companies are long on excuses about why they’ve been so slow to diversify their ranks, even in the face of constant criticism. But by far the most frequently cited reason is they can’t hire diverse employees en masse until the country builds a diverse pipeline of skilled tech workers. With P-TECH, IBM has done nothing if not create a prototype of that pipeline. Now, it’s calling on other tech leaders to take that prototype and do what they do best: scale it to the millions of people – in this case kids – who need it most. (Lapowsky, 2015)

The article also notes that P-TECH fosters an explicitly competitive, entrepreneurial ethos, one well suited to the tech sector itself.

Notably, IBM has produced extensive documentation on the P-TECH model, termed a ‘playbook’, which provides a set of tools and a ‘formula’ for ‘public-private collaborations’ on how such a school should be established, funded, organized and run. The ‘sample skills map’ provided in the online playbook available on the P-TECH website details that ‘software development and support’ is its priority, with ‘strategic growth areas’ for the company itself underpinning the curricula offered in its schools. However, IBM has distributed the P-TECH formula for other organizations to develop. Microsoft and other technology companies, plus engineering, manufacturing and healthcare systems organizations and groups have all taken responsibility for different bespoke schools in the chain. Each sponsor and industry partner in the chain is tasked to define the skills required for jobs in its own school’s field of focus. Local city and state budgets are responsible for the day-to-day financing of the schools, but IBM has itself invested significantly in the development of curriculum materials, technical platforms, advocacy and promotion, and public visibility for P-TECH. In essence, P-TECH is an infrastructural system to support the participation of commercial industries in public education.

P-TECH is also an outgrowth of IBM’s much wider ‘Smarter Cities’ global program, and in particular its Smarter Education strand of R&D activities. The IBM Smarter Education program is based on claims about the real-time availability of educational data and its usefulness in school improvement:

Schools and universities have always recorded and stored data as they tracked grades, attendance, test scores and demographics. With the increasing availability of technology in the instructional process, educational institutions now collect, in real time, data about what their students learn and how they progress ... using big data and analytics.

Like the smart city itself, Linday (2013) claims P-TECH is intended ‘to build for schools what its operations center is for cities: a single system for collecting, aggregating and analyzing data from students and teachers alike, then writing algorithms to prescribe how to cope’. He claims that P-TECH is mobilizing a ‘software “infrastructure layer” for schools, running behind the scenes to manage

students' digital textbooks and analyze their performance', and that P-TECH 'is a research project for gleaning best practices that can be codified into software or peddled by IBM's consultants to other clients – in this case, schools'. P-TECH schools ultimately act as laboratory sites and surveillance centres for IBM to test out its analytics capacities for its commercial Smarter Education agenda, and constitute a talent pipeline for the tech sector, as well as a research site for the production and piloting of software products that might be rolled out to new sites as other industry partners adopt its 'playbook' for educational reform.

Makerschools

Another supply side solution to schooling, but on a different model to P-TECH, is that of the 'makerschool'. The idea of the makerschool has emerged in part from the growing homeschooling culture among technology elites in California. A recent article entitled 'Hacking Education' in *Wired* (Tanz, 2015a) has detailed that many Silicon Valley coders, hackers and makers are now choosing to educate their own children through the DIY logic of digital making. The Silicon Valley homeschoolers see public or state education as fundamentally broken, and perceive makerspaces and hackerspaces as ideal kinds of alternative educational institutions, where children are learning through tinkering, hacking, coding and making, rather than being educated in the prescriptive, standardized mould of schools – a kind of digital age hybridization of progressivism usually associated with John Dewey and the 'unschooling' of John Holt with the edu-hacking culture. The rise of this kind of thinking has been associated with heightened political support for homeschooling through powerful advocacy coalitions (Lubienski, Puckett, & Jameson Brewer, 2013), but also with the 'shadow schooling' of private supplementary tutoring (Bray & Kwo, 2013).

The new makerspace-schoolers acknowledge, however, that such the individualized homeschooling/makerspace model can't work 'at scale'. The technological solution offered by the unschoolers is to create new kinds of 'hybrid' schools, somewhere between homeschooling and traditional school. The prominent example profiled in the *Wired* article is AltSchool (<https://www.altschool.com/>). AltSchool was set up in 2013 by Max Ventilla, a former tech entrepreneur and Google executive, which 'prepares students for the future through personalized learning experiences within micro-school communities'. Its stated aim is to 'help reinvent education from the ground up'. After establishing in four sites in San Francisco as a 'collaborative community of micro-schools', AltSchool expanded in September 2015 to Brooklyn and Palo Alto, with further plans for new schools in 2016. It has since hired executives from Google and Uber (both of which are also involved in education through the HackingEdu annual hackathon) plus other successful Silicon Valley startups. The AltSchool chief technology officer, formerly the engineer in charge of the Google.com homepage and search results experience, has stated that 'I am highly motivated to use my decade of Google experience to enable the AltSchool platform to grow and scale'.

Elsewhere on the AltSchool site, the AltSchool 'platform' is described as a new 'central operating system for education', a scalable technical infrastructure that can be transported to new sites. Its platform primarily consists of a powerful software aggregation and data analytics tool which:

pulls in assessments from individual student work, projects, and 3rd party standards, forming a comprehensive view of a student's progress in each area. An educator can quickly see where a student has demonstrated mastery and where they need to improve specific skills.

In support of this system, its website refers to 'technology-enabled models' that are disrupting other industries and institutions, such as Uber and Airbnb, and applies these ideals to education. As a tech platform, AltSchool is managed on analytical, technical and scientific lines, albeit laced with the progressivist discourse of student-centredness and 'unschooling' from which it draws its central philosophy. As the AltSchool values claim:

Our personalized learning approach puts each child at the center of everything we do ... coupled with state-of-the-art classroom design and technology, [and] a flexible learning environment that mixes individual, group and experiential learning.

Our analytical approach and core strengths in innovation combine educational best practices with the latest tools. Our educators build learning experiences that are adaptive at their core and keep our children engaged.

Run on progressivist learning principles, the makerspace model of AltSchool encourages greater exploration, inquiry and problem-solving through the active construction of knowledge and understanding, whilst monitoring and regulating the experience through learning analytics and adaptive learning software. This is regarded as a scalable solution to standardized schooling. As one interviewee in the 'Hacking Education' article in *Wired* states, 'The cost of starting a company has gone down because there are online tools you can use for free. I can see that happening with school. So much of that stuff is just up for grabs' (Tanz, 2015a).

Setting up a new community of micro-schools, however, is not inexpensive. AltSchool originally raised \$33million in venture capital funding, with a further \$100million investment in 2015, including donations from Mark Zuckerberg of Facebook (Zuckerberg has subsequently announced plans to launch his own startup school, The Primary School, in 2016). AltSchool is, then, thoroughly governed, managed and financed through the discourses and material practices of Silicon Valley startup culture. Its technical infrastructure as a platform is modelled on social media. Its funding is almost exclusively generated through venture capital and tech philanthropy. Its engineering and design team are applying their social media expertise in data dashboards, algorithmic playlisting, adaptive recommender systems and app development to the development of new ed-tech devices and platforms. As a supply side solution to public education, AltSchool also stimulates the demand from parents for new kinds of competitive choices of schools, and for alternative privately-run 'shadow schools' to the standardized model of state and public schooling that is regarded as an outdated and dysfunctional relic of bureaucratic regulation and governmental control. Instead, AltSchool instantiates a new market for corporate-backed private schools, one that is designed to 'scale up' according to a business model imported from the practices of tech-entrepreneurial incubator and accelerator programs.

Experimental R&D lab schools

Khan Academy (<https://www.khanacademy.org/about>) provides thousands of hours of online tutorials and videos to millions online, offering 'practice exercises, instructional

videos, and a personalized learning dashboard that empower learners to study at their own pace in and outside of the classroom'. Its founder, Salman Khan, launched Khan Lab School (<http://khanlabschool.org/>) in September 2014 as another venture philanthropic supply-side solution to schooling. Located in Mountain View, in the San Francisco Bay Area, near Google HQ, Lab School is intended to realize the vision of schooling Kahn had previously outlined in his 2013 book *The One World Schoolhouse*. In the book Kahn (2013) makes a case for 'free, world-class education for anyone, anywhere', where 'deep creativity and analytical thinking' are learned through free-to-use online content, video tutorials and other technologies as the 'survival skills' required in the 'Information Revolution'. Like AltSchool, Kahn Lab School also overtly translates the principles of American progressivist education into its mission statement, not least through discursive symmetry with John Dewey's original Laboratory School at the University of Chicago, where Dewey conducted his original experiments in experiential learning. As an institutional and pedagogical instantiation of this mission, Kahn's Lab School teaches math, literacy and computer programming – in line with its tech sector roots – but also emphasizes 'real world' projects, personalized learning, student-centred learning, and a strong commitment to building children's 'character' and 'wellness' through, for example, 'mindfulness' meditation training.

Most notably, however, Lab School has been established as an experimental R&D lab for testing different educational approaches and technologies, and aspires to contribute to the production of new theories of learning itself. It welcomes outside organizations into the school to test new ideas and technologies, so that the children are positioned as constant willing subjects of a tech experimentalist methodology. AltSchool likewise engages its students in regular human–computer interaction experiments to develop, test and fine-tune its operating system. As an educational R&D laboratory, Kahn Lab School has been profiled in *Wired*, which noted that its

goal isn't just to build one fancy school but to develop and test a new model of learning that can be exported to other schools around the country and the world. His team is diligently recording and tracking every student's progress and sharing the findings with their parents and the staff, an open source approach to educational innovation. In this view, the Lab School kids are guinea pigs ... willingly subjecting themselves to new ideas that have never been tried before, then adapting and adjusting and trying again. 'This is a lab for establishing new theories that could affect the rest of the planet,' Khan says. 'The whole point is to catalyze change'. (Tanz, 2015b)

Lab School's 'touchy-feely surface' of character education, well-being and mindfulness 'masks a rigorous fealty to tracking data about every dimension of a student's scholastic and social progress' (Tanz, 2015b). In particular, it uses data analytics to provide a constant and growing trace of the character development of its pupils, and reinforces those data through standardized testing. Both Kahn Lab School and AltSchool take the original principles of Dewey's Lab School but make them into testbeds for technical systems and HCI experiments.

In particular, the educational operating systems of both Kahn Lab School and AltSchool represent a mishmash of data analytics and character education approaches drawn from positive psychology. They assume that character can be broken down into measurable indicators. This vision is well illustrated by the AltSchool 'recommended reading list', which features a list of texts emphasizing the importance of educational

concepts such as ‘whole-child learning’, ‘personalization’, children’s ‘character’, ‘growth mindsets’, ‘self-control’, ‘resilience’, and ‘creating young innovators’. These texts are all drawn from recent thinkers on character education, positive psychology, educational neuroscience and digital learning – texts which provide a conceptual vocabulary for learning and are rooted in particular disciplinary styles of thinking and theorizing. The image of school children as innovative, self-controlling characters with growth mindsets posited by such texts is woven into both Kahn Lab School and the AltSchool platform, which is described on its website as ‘the magic that allows teachers to architect a personalized educational experience based on each student’s unique circumstances and learning objectives’. What this means is that the data platform acts to perform a continual audit of ‘whole-child learning’ by enacting analytics processes that can mine pupil data for indicators of their character, mindsets, resilience and so on, and then automatically customize or personalize curriculum, pedagogy and assessment around their individual needs. AltSchool and Khan Lab School project a front door that emphasizes new wave psychological concepts of growth mindsets and character development, plus new age ideas about wellness and mindfulness (alongside ideas with longer historical lineages from progressivism and unschooling), which they then track and monitor through surveillant back-end analytics platforms to build data profiles of their students’ character. The pedagogies they design in response to these data-based character insights can then be seen as experimental methods for subsequently intervening in the development of children’s character – a kind of R&D of the person, based on a translation of progressivism, psychology and surveillance into a new tech template for schooling. By so doing, these startup schools reduce learning to the models known by their designers, with the consequence that startup schools emphasize concepts like growth mindsets and character development, and constantly collect data from students as proxy indicators of learning conceptualized according to these categories. Sellar (2015, p. 132) refers to ‘the conceptualisation and codification by which the pre-existing frames, categories and classifications shape the information that is constituted as data and which influence the possibilities for its usage and effects’. Within silicon startup schools, learning is codified according to growth mindsets and character development categories, and allow algorithmic techniques such as machine learning to make predictions about students’ progress according to these reductive psychological classifications.

Crowdsourced super schools

Finally, XQ Super School Project (<http://xqsuperschool.org/>) is a competitive project intended to support developers to rethink the model of high school in the US. Set up in September 2015 with \$50million philanthropic investment by Laurene Powell Jobs, the wife of Steve Jobs from Apple who died in 2011, the XQ Super School Project is managed by the XQ Institute, itself an incubated product of the Emerson Collective (<http://www.emersoncollective.com/>), a philanthropic organization that claims to ‘invest in ideas and fuel innovation’ through partnering with entrepreneurs. Its founder and president is Laurene Powell Jobs (one of the richest women in Silicon Valley, and the world’s ninth wealthiest woman) and its managing director is Russlynn Ali (a former assistant secretary in the US Education Department). There is serious financial

and entrepreneurial Silicon Valley power twinned to policy power in the Super School Project.

In practical terms, the XQ Super School Project is conceived as a massive ‘democratic and crowdsourced’ experiment in school design. It is promoted as an open competition ‘to reimagine and design the next American high school’ in order to ‘deeply prepare our students for the rigorous challenges of college, jobs and life’. Launched with a significant social media campaign including high-production video content and a celebrity event modelled on a new product launch for an Apple device, the Super School Project is based on the claim that schooling has remained static for a century as a ‘dangerously broken system’, while the wider society has experienced waves of technological innovation. The project began soliciting proposals in late 2015, with the objective of partnering with winning teams to provide them with expert support, including the allocation of \$50million funding for the winning five proposals to turn them into ‘real Super Schools’. In addition to the main competition, the project has actively sought to crowdsource ideas for school innovation through the Twitter hashtag #RethinkHighSchool, and facilitated a roadshow in autumn 2015 to encourage design teams to gather together, discuss their ideas and get input from the project team. XQ Super School Project takes the template of the education hackathon, such as HackingEdu, as well as the ed-tech incubation and acceleration model, and transplants them into a school redesign competition.

Despite being an open, crowdsourcing competition, XQ Super School Project is designed with a number of clear constraints for potential entrants. Notably, it assumes that neuroscience is the best place to start in understanding learning processes. A paper on the ‘science of learning’ provided on the website refers to ‘understanding and applying the fundamentals of brain science’ to ‘empower young people to become agents of their own learning journeys’. It draws on neuroscientific claims about the malleability and ‘neuroplasticity’ of the ‘adolescent brain’, about the brain-based nature of students’ ‘mindsets’, and particularly applies these to the idea that Super Schools should aspire to ‘foster a mathematical mindset’. In this sense, XQ Super School Project is an instantiation of the recent interest in ‘neuroeducation’ and the proliferating discourse and practices of neuroscience in education. As Pykett (2015, p. 97) notes, however, there is often a tendency in neuroeducation to treat the functional architecture of the brain in explicitly determinist terms, and even ‘to reduce learning to an algorithmic or computational process’.

In another paper on the skills students require in the twenty-first century, the XQ Super School Project dismisses the so-called ‘old paradigm’ (of following orders, being product-driven, 9-5 lifelong employment and domain specialization), and replaces it with the ‘knowledge economy’ paradigm of co-creation, distributed leadership, flexibility, domain agility and creativity. These twenty-first century skills have become a kind of mantra in the tech sector, and are reflected in numerous other initiatives led by the technology companies, most notably the influential Partnership for 21st Century Learning, which are concerned with cultivating the skills associated with STEM subjects (science, technology, engineering and maths) and accord closely with the workforce priorities of the tech sector itself (see Williamson, 2013). As XQ Super School Project illustrates, theories of neuroscience wedded to economic rationalities are becoming the dominant ways of thinking about processes of learning. However, as Pykett (2015,

p. 135) notes, ‘the fundamental problem of applying neuroscientific insight’ to educational practice ‘is that neuroscience can only study pre-conceived psychological theories, not actual behaviour’. In other words, the appeal to neuroscience is often used to confirm pre-existing psychological concepts and theorizations of behaviours. Thus XQ Super School Project makes young people’s STEM mindsets into characteristics that can be activated through the brain. The promise here appears to be of activating human capital through brain-targeted pedagogies. Roberts-Mahoney et al. (2016, p. 1) have recently articulated how many educational data analytics systems (like those employed at P-TECH, AltSchool and Kahn Lab School) are based on categories that measure skills in terms of ‘human capital’:

Big data and adaptive learning systems are functioning to redefine educational policy, teaching, and learning in ways that transfer educational decisions from public school classrooms and teachers to private corporate spaces and authorities. [They] position education within a reductive set of economic rationalities that emphasize human capital development, the expansion of data-driven instruction and decision-making, and a narrow conception of learning as the acquisition of discrete skills and behavior modification detached from broader social contexts and culturally relevant forms of knowledge and inquiry.

The student of a silicon startup school is therefore addressed through pedagogies and technologies inspired by neuroscientific, psychological and economic categories that are as much political as they are empirical: they rely on contests between different forms of expertise that differently assert what learning is, how to improve and activate it, and how to measure it when it becomes visible. In this context, the student of a silicon startup school becomes the subject of a kind of R&D process where human subjectivity and behaviour itself is seen as the site for radical disruption and innovation.

Discussion: ‘disrupting’ public education

Silicon startup schools represent in prototypical form a model for the future of schooling that is emerging from the technocratic mentalities, algorithmic imaginaries and venture philanthropy of the tech sector as a radically ‘disruptive’ alternative to public education. As the analysis of the content of the four project websites, web searches around their originators and associated media commentary has demonstrated, these projects emerge from and reinforce the technocratic mentality and algorithmic imaginary associated with Silicon Valley entrepreneurial culture which asserts that the problems of schooling can be fixed through the application of technical solutions written in code and funded philanthropically. The role of venture philanthropy has been well-documented in relation to US charter schools, UK academy schools and other privately funded excursions into education reform and policy entrepreneurship (Au & Ferrare, 2015; Ball & Junemann, 2012; Lubienski, 2013; Olmedo, 2014; Reckhow, 2013; Saltman, 2010), but the specific involvement of Silicon Valley high-tech entrepreneurs in establishing their own models of schooling opens up a new and challenging site of inquiry. In particular, the establishment of startup schools by Silicon Valley entrepreneurs represents a concerted emerging corporate reform movement that translates the technocratic mentality of the technology sector into the obligations of educational

institutions. The intersection of an algorithmic imaginary with venture philanthropy raises a number of points for discussion and further examination.

First, the silicon startup schools being developed by Silicon Valley entrepreneurs such as IBM's P-TECH model, Salman Khan's Lab School and the AltSchool platform, are ultimately new kinds of educational 'code/spaces' that thoroughly depend on coded infrastructures and devices to function as intended and designed. Kitchin and Dodge (2011) assert that understanding how code/space functions means looking beyond the lines of code themselves. It means examining the programmers who script code to accomplish specific goals; the professional and institutional cultures of coding in which code is written; the financial and business arrangements that fund it; the social and technical infrastructures in which it is embedded; the management and governance structures that regulate it; and, not least, it requires close attention to the work that the code does in the spaces in which it performs. Within the silicon startup schools detailed above, the organizational culture of tech incubator and accelerator programs are now being embedded in the culture of schooling. These schools are sites in which new technologies and related pedagogic approaches to teaching and learning – informed by neuroscience, growth mindsets, character development and so on – are being incubated, prototyped, tested and validated, prior to being accelerated through further investment and expansion. In this sense, they relocate not just the technical platforms of Silicon Valley into the space of the school, but also implant in it the social practices and code cultures of the tech sector, including those of hackathons, tech incubation, crowdsourcing, venture capital competition and scale-up acceleration. Silicon startup schools are orchestrated by lines of code, but also the codes of conduct, knowledges, legalities, ethics, financial arrangements and so on that regulate and govern production in the technology sector.

Second, it is the vocabulary of Silicon Valley which is supporting the kinds of coding practices that will make startup schools operational. Notably, AltSchool, P-TECH and Kahn Lab School were all profiled in the technology magazine *Wired* in 2015 – a clear indicator of discursive symmetry with the entrepreneurial technology sector. The Silicon Valley discourse of innovation, entrepreneurship, startup culture, makerspaces, crowdsourced solutions, platforms and philanthrocapital is becoming a new language of schooling. These schools are the prototypical products of venture philanthropy and are consistent with 'the increasing centrality of business terms to describe educational reforms and policies' which:

treats giving to public schooling as a 'social investment' that, like venture capital, must begin with a business plan, involve quantitative measures of efficacy, be replicable to be 'brought to scale,' and ideally 'leverage' public spending in ways compatible with the strategic donor. (Saltman, 2010, p. 2)

P-TECH is perhaps prototypical of the venture philanthropy vocabulary in this sense, setting up schools in IBM's own terms by 'giving' them technical and curricular materials, but also by promoting its playbook for use by other commercial partners and simultaneously delegating responsibility for funding and day-to-day management to local government. Other silicon startup schools – AltSchool and Kahn Lab School especially – represent the next restless step of venture philanthropy, which has been to identify markets for privately run fee-paying schools for choosy parental markets that have increasingly abandoned the public education system altogether. Projects such as

AltSchool, P-TECH, Kahn Lab School and XQ Super School rely on both venture capital and philanthropy, or venture philanthropy that, as Saltman (2010, p. 1) phrases it, 'contributes to both the privatization of schooling as well as the transformation of public schooling that is based on the model of corporate culture'. Such schools do little to support public education, instead devaluing and discrediting it as a 'dangerously broken system', as the XQ Super School marketing blurb reads – a claim that reinforces the 'manufacturing' of 'educational crises' in American education (Berliner & Biddle, 1995) and that Saltman (2010, p. 35) terms 'killing public schools with kindness'. The language of broken systems and new operating systems that might 'scale up' clearly inserts tech entrepreneurial discourse into school. Rather like the 'shadow education' provided by private supplementary tutoring (Bray & Kwo, 2013), Silicon Valley's shadow schools represent a market-based and technocratic solution to the model of state schooling that has been problematized as broken. The language of an eduOS – a technical operating system for education – ignores the messy complexity of social context, and implies that technical solutions can be applied as software patches or upgrades to outdated and buggy systems.

Third, startup schools are also changing the governance structures of schooling to include tech entrepreneurs, venture philanthropists and software engineers in the management teams of schools. These schools are governed technocratically by technological expertise and knowledge, financed by web giants, and organized through the software products they produce. These new technocratic entrepreneurs of corporate education reform not only have their own technical ways of doing things; they also see the world in particular ways, and identify problems in ways that can be solved through particular means, or 'silicon bullets' (Lynch, 2015b). In the imaginary of silicon startup schools, local and national governments will no longer have responsibility for schools; education will be governed through Silicon Valley HQs, operationalized by software engineers, and financed by corporate, venture and philanthrocapital funding. As Olmedo (2014, pp. 577–78) notes, philanthropic governance entails the 'degovernmentalization' of education as 'monopolistic control over state actions' is redistributed to other actors with 'different backgrounds, profiles and interests' and that aspire to act as new sources of expertise in educational matters. In terms of governance, UK school boards of governors are already being transformed into more businesslike, entrepreneurial outfits (Wilkins, 2015), and there is more commercial involvement as well as philanthropic governance of schools through the academies program (Ball & Junemann, 2012; Olmedo, 2014). In addition, Silicon Valley's startup schools are seeking to accelerate the process of data-driven school evaluation associated with the charter school movement (Reckhow, 2013). Startup schools have direct access to their data, and can collect and calculate it in-house and in real time – a significant example of the 'capture model' (Agre, 1994) of data collection that allows computers to track information in real time, identify particular human activities and reorganize the data sets in ways that can be used for intervention. In this way startup schools act much like the social media companies from which they are derived, whose business plans depend on the capture and analysis of customer and user data, often with little external scrutiny, for the purposes of better profiling and prediction of individuals' habits and social trends. They firmly lodge the algorithmic logic that everything is objectively calculable, predictable and manageable through technical systems – and the associated

technocratic mentality that value-free technical expertise is preferable to political conflict – in the institutions of schooling. Silicon startup schools extend corporate expertise in the governance of schools to tech elites with their own distinctive technocratic mentality of data-driven and algorithmically optimized software solutionism.

Conclusion

While prototypical startup schools may be conceived as ‘angel investments’ from Silicon Valley that will ‘radically disrupt’ the social institution of public schooling, they also need to be understood as the products of an algorithmic imaginary that is rooted in a technocratic mentality of technical innovation, venture philanthropy, commercial business planning and social media data capture, as well as being continuous with corporate education reforms that have sought to create ‘shadow schools’ as competitive alternative marketplaces to state schooling. The glossy imaginary of smarter, crowdsourced, silicon startup schools conceals how they are also surveillant, data-capturing, experimental laboratories and scalable venture capitalist schools built to run on the social, cultural, economic and political operating systems of Silicon Valley itself. They represent a significant instantiation of Silicon Valley venture philanthropy in education that involves imagining and inscribing education through the language of the technology sector and seeking to remodel public education according to its technical template. In this sense, their technologies are political. They constitute the material products of Silicon Valley’s political imagination which assumes educational problems can be rectified with technical solutions, and that new technical innovations can act as catalysts of political innovation (Ferenstein, 2015).

Jasanoff (2015, pp. 5–6) has referred to sociotechnical imaginaries as the myriad ways in which scientific and technological visions enter into social life:

Though collectively held, sociotechnical imaginaries can originate in the visions of single individuals, gaining traction through blatant exercises of power or sustained acts of coalition building. Only when the originator’s vision comes to be communally adopted, however, does it rise to the status of an imaginary. ... Imaginaries, moreover, encode not only visions of what is attainable through science and technology, but also of how life ought, or ought not, to be lived.

As parts of an increasingly shared, stabilized and institutionalized imaginary of the future of education that have now exceeded the vision of their entrepreneurial originators and become a dominant vision among likeminded coalitions of technology sector advocates, silicon startup schools can be seen as expressions of how young people should live their lives. This powerful imaginary is confirmed in a book co-authored by Google chief executive Eric Schmidt, which states:

the modern technology platforms, such as Google, Facebook, Amazon and Apple, are even more powerful than most people realize, and our future world will be profoundly altered by their adoption and ... the speed at which they scale. Almost nothing short of a biological virus can spread as quickly, efficiently or aggressively as these technology platforms, and this makes the people who build, control and use them powerful too. (Schmidt & Cohen, 2013, pp. 9–10)

Silicon startup schools are based on a similarly optimistic view of the pervasiveness of technologies, driven by powerful individuals whose imaginings of the future can spread virally to become shared and collectively adopted. They are becoming diagrammatic of a desirable future of education, driven by logics that originate outside of the education sector and instead by the imperatives of innovative R&D, competition for venture philanthropy, the demand for new technology marketplaces, and the accumulation and consolidation of power among technocratic elites. Advancing on the development of charter schools in the US and academy schools in the UK, they are emblematic of an increasing transferral of ‘power away from democratic processes towards new sources of “expertise” and influence that represent ... “privatized policymaking”’ (Lubienski, 2013, p. 510) and the shaping of public policymaking processes by corporate education reformers. Political support for P-TECH, the participation of policymakers in XQ: Super School Project and the rapid scale up of AltSchool are all evidence that these models and the entrepreneurs behind them are becoming politically attractive technocratic alternatives to bureaucratic state governance – policy entrepreneurs of an emerging educational technocracy. These schools act as normative diagrams for future schools based on algorithmic data analytics platforms transplanted from the social media sector; they are staffed by technical experts with their own code cultures and professional practices; subscribe to psychological and neuroscientific categorizations of character and mindsets for learning; receive funding through competitive venture philanthropy; have been prototyped and developed according to the business model of incubator and accelerator programs; and are governed through networks of corporate power rather than public processes. Silicon startup schools represent the displacement of power from the institutions of public education by attracting political and public support toward the technocratic imaginary of high-tech corporatized schooling.

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